Space Weather Technical Forecast

Issued on Saturday 15 February 2025 at 12:30 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1. Likely R1/R2. Likely Active 24-hour electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate solar activity was observed in the last 24 hours, with one M-class flare occurring from AR3990 in the southeast, with peak flare an M1.8 observed at 14/2057UTC.

There are currently twelve sunspot regions on the visible disc, of which ten are numbered. There are five notable regions at present, the first of which is AR3990 in the southeast nearing centre disk. This spot has a large central asymmetric spot surrounded by peripheral spots, most of which are small, though one of opposite polarity leading to it's more complex classification. AR3992 in the southwest continues to see its intermediate spots fade. AR3994 near south centre disk is a small and apparently unremarkable region, yet has been the source of a number of flares and faint CMEs on 14 Feb. AR3995 unusually remains within the southern coronal hole/s, splitting it in two. Finally AR3996 continues to rotate into view, and is rather bright on SDO94 imagery. All other spots are relatively simple with only little changes observed.

Several faint CMEs were observed leaving the Sun on February 14th, likely originating from AR3990 or AR3994. Additionally, a CME from a filament eruption in the northeast of the disc was observed at 15/0107 UTC. There is a chance of glancing impacts between February 16–18 (Days 2–4), although confidence is low.

Solar Wind / Geomagnetic Activity: Solar winds as measured at L1 by ACE, showed an ongoing connection to a fast wind, likely that emanating from CH14/-. The solar wind speed was erratic due to the low solar wind density (single figures ppcc), but showed an overall rise from elevated levels of 500km/s to strong levels of around 620km/s by the end of the period. The IMF showed a flat weak-moderate trend (6-9nT). The north-south component varied between +6 and -9nT, with this mainly anti-aligned with Earth's field to accentuate geomagnetic activity. The net result of the above solar wind measures was Unsettled to Active geomagnetic activity, with a peak of G1/Minor storm (Kp 5) 15/0900-1200UTC.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 persisted at Background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at diurnally high levels, peaking at 6600pfu at 14/1600UTC, before falling below the active threshold overnight before becoming high

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again from 15/1135UTC. The associated 24-hour fluence briefly became active for a single interval at 14/2100UTC, but has remained close to the active threshold. The 15/0001UTC observation was 9.68e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Further isolated M-class flares are considered Likely, probably from AR3990, AR3992, or AR3996.

Solar Wind / Geomagnetic Activity: Several faint CMEs give a chance of glancing impacts days 2-4 (16-18 Feb). Coronal hole fast winds from CH14/- continue, with a general steady trend expected days 1-2 (15-16) Feb, with a slow declining trend thereafter, with speeds peaking around 650 km/s.

Predominantly Unsettled to Active geomagnetic conditions are expected throughout, with a chance of G1/Minor geomagnetic storm (Kp 5) intervals due to coronal hole influences or glancing CMEs. By the end of Day 4 (18 Feb) solar wind speeds and current CME risks are expected to diminish, with geomagnetic activity falling back to Quiet to Unsettled levels (Kp 0-3). The main forecast uncertainty is perhaps the duration of the enhancement, although the peak magnitude is not expected to exceed G1 levels.

Energetic Particles / Solar Radiation: High energy proton flux is forecast to persist at Background levels, with a marginally increasing Slight Chance of a S1 event given the westward progression of current active regions.

The high energy electron flux is generally expected to become diurnally high each day, with an increasing Likelihood of reaching Active fluence, though confidence is low, and the forecast may prove volatile until CH14 and CH15 rotate closer to the western limb.

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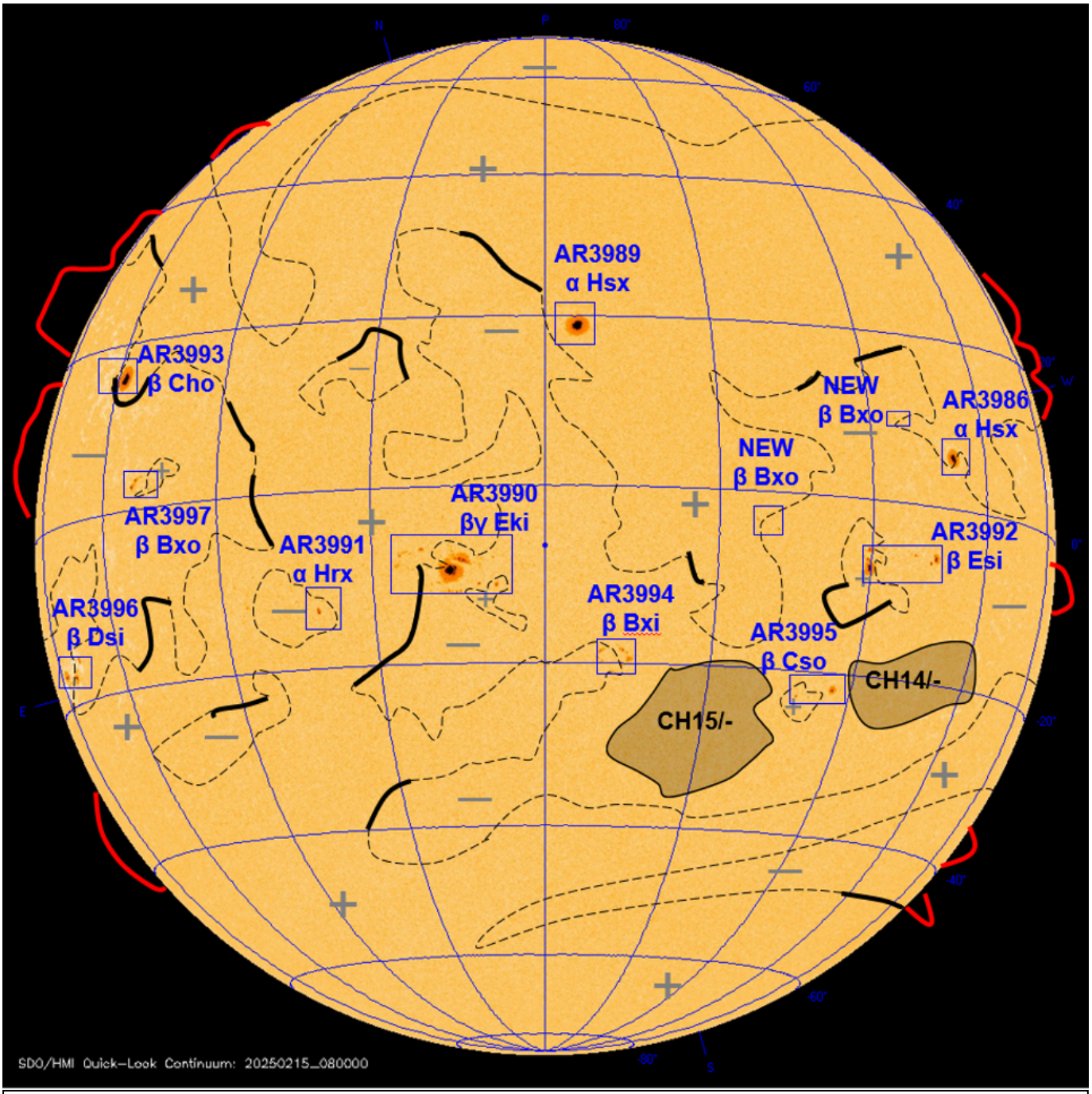
Figure 1: Solar synoptic map valid 15/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

Several faint CMEs were observed leaving the Sun on February 14th, likely originating from AR3990 or AR3994. Additionally, a CME from a filament eruption in the northeast of the disc was observed at 15/0107 UTC. Confidence in all of these CMEs remains low due to the absence of clear dimming in imagery and the influence of nearby coronal hole fast winds. The analysis is further complicated by suspected far-sided events. As a result, there is a chance of glancing impacts between February 16–18 (Days 2–4), with a low risk of some of these CMEs merging.

Coronal hole fast winds from CH14/- continue but have now split, with its rearward portion designated as CH15/-. Despite this, a sustained period of elevated-strong winds is expected, with a seamless transition from CH14/- into CH15/-. Solar wind speeds are anticipated to remain relatively steady through Days 1–2 (Feb 15–16), possibly seeing a slight increase, peaking around 600-650km/s. From Day 3 (Feb 17) onward, a slow declining trend is expected, potentially reaching slightly elevated levels by the end of Day 4 (Feb 18). This forecast is supported by MOSWOC ENLIL, which shows only minor deviations related to the previously mentioned glancing CMEs.

Predominantly Unsettled to Active geomagnetic conditions are expected throughout, with a chance of G1/Minor geomagnetic storm (Kp 5) intervals due to coronal hole influences or glancing CMEs. By the end of Day 4 (18 Feb) solar wind speeds and current CME risks are expected to diminish, with geomagnetic activity falling back to Quiet to Unsettled levels (Kp 0-3). The main forecast uncertainty is perhaps the duration of the enhancement, although the peak magnitude is not expected to exceed G1 levels.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	50	50	40	30
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Figure 2: MOSWOC ENLIL, showing the possible glancing arrival of CME/s as they arrive at 1AU.

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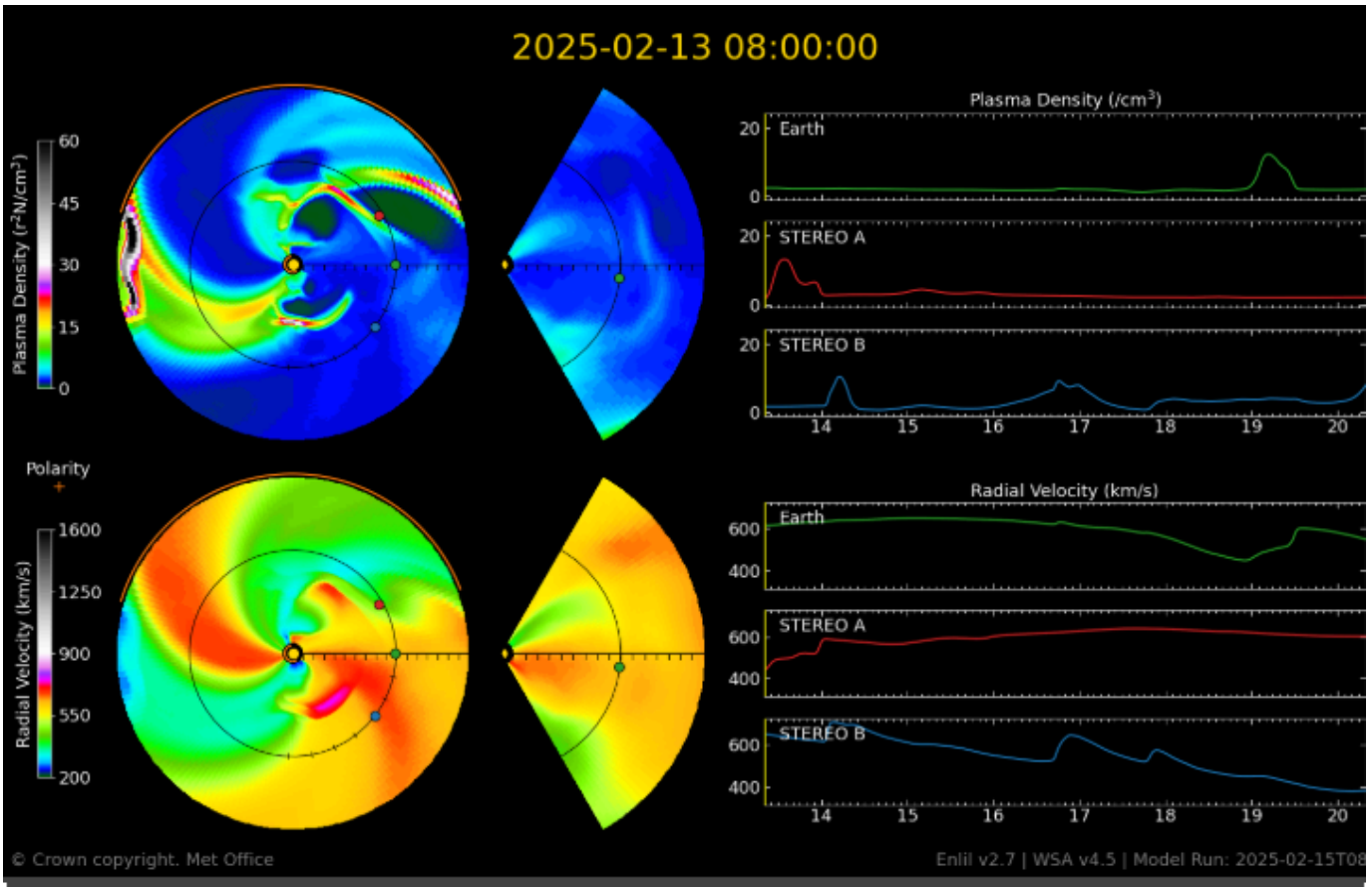

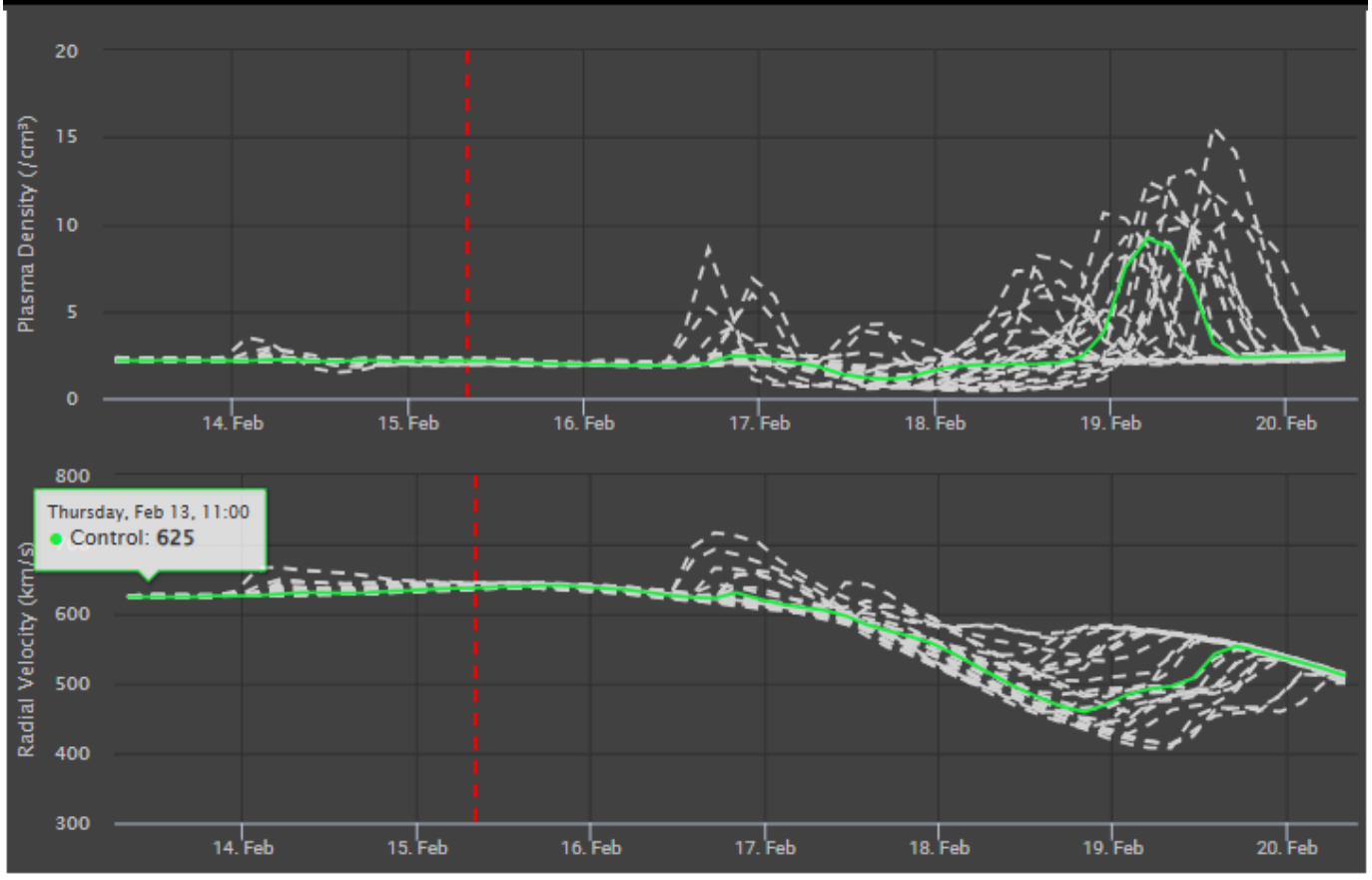

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Radio Blackouts - X-Ray Flares

Moderate solar activity was observed in the last 24 hours, with one M-class flare occurring from AR3990 in the southeast, with peak flare an M1.8 observed at 14/2057UTC.

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Further isolated M-class flares are considered Likely, probably from AR3990, AR3992, or AR3996.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	Yes	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

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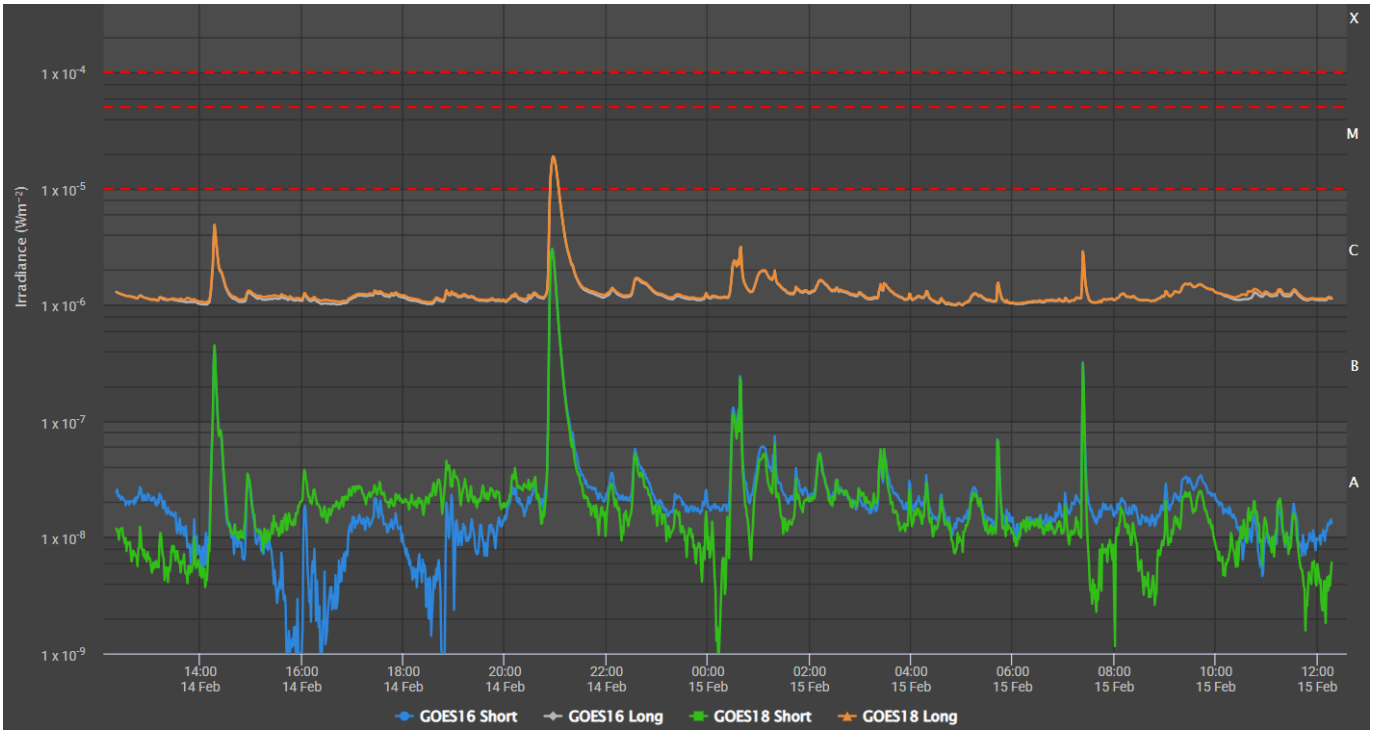
Figure 3: 24 hour X-ray trace



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Solar Radiation Storms (High Energy Protons)

GOES18 proton flux is most likely to persist at Background levels, but with a slowly increasing daily Slight Chance of enhancement from any notable flares from AR3992 in the western hemisphere or AR3990 as it rotates into a more favourable position into the western hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

Confidence in the high energy electron forecast remains low. There are competing factors affecting flux levels, the sustained solar winds and geomagnetic activity from CH13/- and CH14/- have been sufficient to charge but not significantly compress the Van Allen belt and its High electron populations at GEO. This has led to diurnal peaks at high electron flux levels. Occasional drop-outs to Normal Background flux are still probable. In time as the coronal hole high speed stream eases, flux levels may become more persistently high. On the other hand possible glancing CMEs may also act to clear a portion of electrons from GEO.

An associated slight increasing trend is expected for electron fluence levels, with an increasing Likelihood of rising above Active by days 3 and 4 (17/18 Feb). MOSWOC REFM is proving quite reactive to current counts at GEO and shows a relatively flat trend close to Active.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	60	60	70	70
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

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Figure 4: MOSWOC REFM

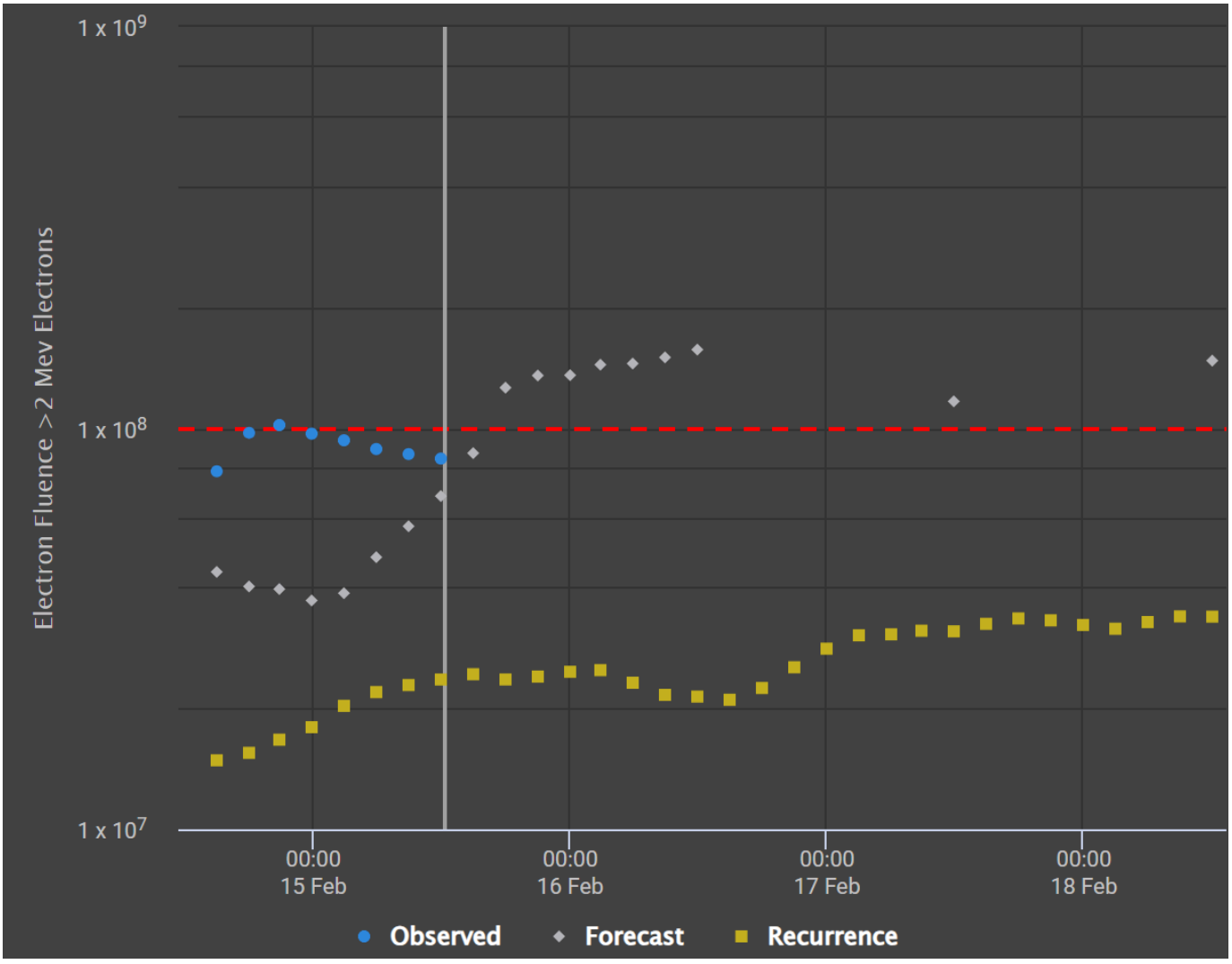
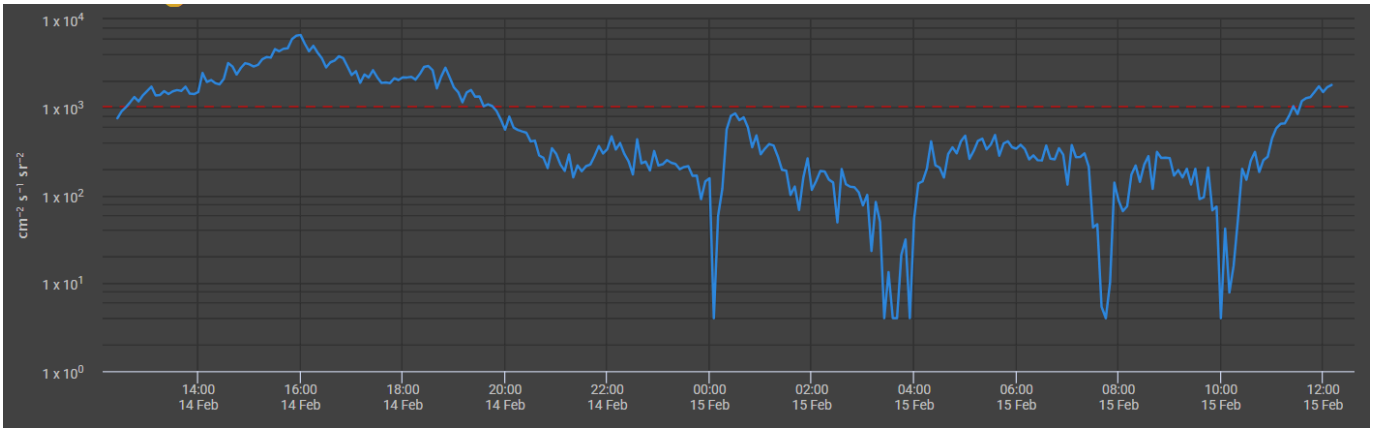


Figure 5: 24 hour electron flux trace



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